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THE MONIST

THE THEORY OF ENERGETICS AND ITS PHILOSOPHICAL BEARINGS.

THE theory of "Energetics" so called, first propounded by Rankine some fifty years ago, has been revived recently in Germany. The *Energetiker* have not been satisfied with their endeavor to formulate a new theory of physical science, but essay the field of philosophy as well. There is no name more eminent, or one which is more closely identified with this novel movement of thought than that of Ostwald. In his lectures on *Naturphilosophie* delivered in Leipzig during the summer of 1901, he gathered about him a number of enthusiastic admirers and followers, disclosing to them the mysteries of science and philosophy as made manifest in the universal solvent,—the concept of energy. In a letter which I have received from an acquaintance who has recently been in Germany, the attitude towards Ostwald in academic circles is aptly described as follows. "The men in philosophy fear his science, and the scientists fear that there is something in his philosophy."

His may be styled a philosophy without hypothesis, for such is his claim, that the system which he offers is founded solely upon observed facts, and that these facts of themselves form a compact system which needs no metaphysical speculation whatever in its construction.¹ He insists, moreover, that it is the physicist, and he alone, who is entitled to an opinion in matters philosophical; for he only is in possession of the facts, and facts alone have philosophical significance. There seems to be a strange fascination to

¹ *Naturphilosophie*, p. 181.

the physicist, and to the biologist as well, in the region of philosophy which lies so alluringly without the field of their specialties. Now and again, they look up with an eager and questioning wonder from the circumscribed area which bounds their tasks to the great world and the world-problems.

The claims of the *Energetiker* as expressed by Ostwald may be briefly summarised as follows:

If we put to ourselves the question, "Which is the most universal and comprehensive concept employed in scientific circles to-day, and the one to which all other concepts may be appropriately referred," we are constrained to confess that it is none other than the concept of energy.¹ By energy, moreover, is to be understood whatever is the result of work, or whatever may be transformed into work.² Thus when reduced to their lowest terms, the traditional concepts of metaphysics, that of substance and that of causation, may be more adequately and precisely expressed as varied manifestations of the fundamental concept of energy.³ The concept of matter from this point of view becomes superfluous, for energy needs no substratum or vehicle to render it any more elemental in character, or any more intelligible.⁴ The essential properties of matter may be more satisfactorily expressed under the concepts of *Form-energy* and *Volume-energy*. The *Form-energy* is that property of a body by virtue of which it is capable of maintaining its form, or it is that amount of energy which must be applied to the body in question in order to produce any deformation. The *Volume-energy* is defined as that amount of energy which is necessary in order to preserve the volume of a body, or to change it as a whole through the process either of contraction or expansion. When, for instance, we say that we feel a material thing, as we put our hand upon a book or a desk, it is really the experience of some changed form of our organism which we feel, and which is due to the manifestation of the energy induced by the grasp of the hand.⁵ Aside, therefore, from the properties which may be expressed as forms of energy, matter remains

¹ P. 152.

² P. 159.

³ P. 153.

⁴ P. 165.

⁵ Pp. 168, 169.

a pure abstraction. Matter, consequently, gives place to energy, and with the passing of matter that most perplexing of all philosophical difficulties, the transition from physical to psychical phenomena, becomes immensely simplified. For, as Ostwald puts it, the concept of energy seems to be far more *geistig* than that of matter.¹ It is possible to conceive more readily of psychical energy as a kind of transformed physical energy, than to conceive of the essential coördination of matter and of mind. The nervous energy into which the physical energy of the external stimulation is transformed by the organs of sensation, seems to be one degree nearer the psychical energy. It is so near of kin at least that it is possible to regard its peculiar function to be that of liberating the stored energy of the brain which manifests itself in the varied wealth of psychical phenomena.² The transition, therefore, to this central nervous energy with the unique characteristic of consciousness attached to its manifestations, is relieved of many, if not all, of its traditional difficulties.

As motion is to be regarded as the differentiating characteristic of kinetic energy, so also consciousness may be regarded as the differentiating characteristic of this central energy of the brain.³ When we come to the more complex forms of this central energy, as manifested in the phenomena, for instance, of volition, we find that the resulting activity in all cases may be referred to some liberating cause in the form of nervous energy acting upon the stored volitional energy within the central organ.⁴ This general position as thus briefly outlined is fortified by a reference to three analogies, which by the way is a form of proof presenting rather shifting ground upon which to construct so important a doctrine as is the main contention of Ostwald.

1. It is insisted that there is no more difficulty in effecting the transition from the various forms of physical energy external to the organism to the nervous energy within it, than the subsequent transition from this nervous energy to that unique form of nervous energy which is centrally liberated and which is attended by con-

¹ P. 148.

² P. 392 f.

³ P. 396.

⁴ P. 426.

sciousness. The one transition, it is affirmed, is wholly analogous to the other.¹

2. The question may be suggested at this point, Why is not all nervous energy and indeed all forms of energy whatsoever attended by consciousness? Ostwald answers this by the following analogy:

As a few crystals, not all, give manifestations of electrical energy under pressure, so also not all forms of energy are attended by the manifestation of consciousness, but only in the unique case of the central energy of the nervous system.² This relieves Ostwald of the necessity of correlating consciousness with all forms of energy whatsoever.

3. He adduces a third analogy as follows: As a relay battery in electricity produces its stored energy in such a manner that the resulting effect is out of all proportion to the liberating cause, so also the centrally stored energy gives results often seemingly incompatible with the nervous energy which has acted as its exciting and liberating cause.³ Such being the statement in general of the position maintained by the *Energetiker*, particularly as formulated by Ostwald, let us proceed to an examination of its fundamental and essential claims.

The theory, as at present developed, has not yet substantiated its claims in the field of physics pure and simple, setting aside entirely all consideration of its claims in the field of philosophy. For instance, Boltzmann has pointed out several mathematical incongruities in Ostwald's theory which would indicate that it is not wholly free from some mathematical presuppositions at least which are precariously uncertain. The philosophy without hypothesis is thus challenged at the start, and in reference to its fundamental basis.⁴

Boltzmann also draws attention to the fact that Ostwald grounds his theory in a concept of energy which he regards as elemental; to be accepted simply, and as impossible of reduction to any lower terms. And yet the mathematical expression of energy

¹ P. 396.

² P. 397.

³ P. 392 f.

⁴ *Annalen der Physik und Chemie*, N. F. Band 57, P. 46 f.

is that of $\frac{1}{2}mv^2$, one half the mass into the square of the velocity. But when asked to define the meaning of mass, Ostwald gives its definition in terms of kinetic energy. And we find ourselves confronted by the circle,—energy defined in terms of mass, and mass in turn in terms of energy.

Moreover, in reference to the concept of Volume-energy, Planck has drawn attention to the fact that the *Energetiker* have employed an integral which involves them in certain mathematical difficulties. This integral is $\int p dv$, where p is the pressure, and v the volume of a gas. Now any given physical energy which passes through a cycle of changes and returns to its initial state must regain its original value without a loss of energy, and this the mathematical symbols and processes should indicate. But this particular integral indicates that a change in the quantity of energy occurs through the process of a return to its initial state. Planck concludes that “there is in general no significance whatsoever in the term, the Volume-energy of a gas, in the sense of its designating any physical quantity which can be reckoned with mathematically.”¹

In general it may be said that the theory of energetics applies only to reversible processes, that is, wherein the returning cycle of changes shows no loss of available energy, but that wherever there is such a loss it fails of describing adequately the phenomena in question. As Mach has put it, “The principle of energy is superfluous in reference to a quantity of heat that can no longer be transformed into mechanical work.”²

Such a state as Mach describes is an excellent illustration of an irreversible process. The theory of energetics, therefore, seems to overlook the second law of thermo-dynamics which expresses the tendency of all energy to become transformed into unavailable states.

Although the foundations of this theory of energetics are by no means grounded upon a secure mathematical and physical basis,

¹ *Annalen der Physik und Chemie*, N. F. Band 57, P. 72.

² *The Monist*, Vol. V., p. 49. *Popular Scientific Lectures*, 3rd ed., p. 178.

let us suppose, however, for sake of argument that its mathematical ground, expression, and applications have been proved in a highly satisfactory manner; nevertheless, it by no means follows that the dark places of philosophy are illumined by its light to the extent as claimed for it by Ostwald. Let us undertake some critical considerations of his position in this regard. It may be of assistance to us in getting our bearings in this discussion to recall a statement of Poincaré to the effect that whenever any physical system has been portrayed by means of some mechanical expression of its interrelations and interactions, then also an indefinite number of other mechanical expressions is possible which will as adequately embrace the entire situation and as completely fulfil its tests and conditions. Whether we agree with him in this statement, is not to the point. For our present purpose it serves at least to emphasise the point, that any mechanical explanation whatsoever, whether the traditional theory or the new theory of Energetics, does not in any sense purport to give an exposition of the real significance of the phenomena which it describes. If therefore the theory of Energetics does not and can not express the essential nature of physical phenomena, how then can it reveal to us the significance of psychical phenomena and their relations to the physical?

Coming, therefore, to this main problem, the transition from the physical to the psychical, Ostwald's theory does not touch in the remotest manner the outstanding difficulty which is involved. His theory is based essentially upon the principle of the conservation of energy which renders possible the correlation of the various forms of physical energy as regards their quantitative equivalence. But when it is proposed in a like manner to correlate the nervous energy of the bodily organism with the so-called psychical energy, it must be borne in mind that there is this essential difference, the latter correlation is a qualitative one while the former is quantitative. The insidious influence of analogical suggestion in directing the trend of Ostwald's thought has proved in this connection most misleading. The theory of energetics is primarily a means of expressing quantitative equivalence; but psychical phenomena not

merely elude all attempts to express their quantitative equivalence in respect to the nervous phenomena accompanying them, or in respect to the more remote physical phenomena which act as the external nerve stimuli, but it is impossible to express them in terms of any quantitative nature whatsoever. Ostwald says, "We start with a datum which embraces only that which can be proved and demonstrated through experiment and measurement."¹

This statement occurs in connection with his attempt to ground his theory solely upon observed physical phenomena, and in order to express his disdain of hypothesis and vague speculation. If, however, in the premises there is only the measurable, how can there be in the conclusion that which wholly transcends all measurement? It is impossible to correlate a given quantity of brain-energy with a concomitant variation as regards the quality of any mental state whatsoever.

Ostwald insists that the chemical changes in the central organ of the nervous system cause a liberation of the stored psychical energy.²

The very phrase which is used, "stored psychical energy," implies something of a physical nature as its vehicle, and the transition from the liberating energy which is chemical to the resulting psychical phenomena remains as much a mystery as before. Even though the liberating energy may be conceived as reduced to an infinitesimal amount, it is still physical, and the liberated energy is psychical. The general expression of energy in terms of $\frac{1}{2}mv^2$ represents its essence under space and time-conditions. Ostwald himself states that "energy has play only in portions of space in which mass and gravity are present together."³

But mental phenomena present no such characteristics in themselves. It is impossible to think them under such categories. Therefore this unique manifestation of consciousness which, it is alleged, must be regarded as the differentia of the central nervous energy, is either the same in kind as that of nervous energy or it is not.

¹ P. 181.² P. 377.³ P. 191.

If it is the same, it can be known only under space and time-conditions, and is consequently a disguised form of mass and velocity relations.

If, on the other hand, it is not the same, it falls outside of the concept of energy altogether and remains unexplained from the point of view of the *Energetiker*.

Aside from all representation by means of any formulæ, the concept of energy conceived as a form of work does not express the fundamental nature and essential characteristics of psychical phenomena. Not even through the wildest flight of the imagination or through the most grotesque phantasy is it possible to represent thought as a form of work, or as capacity for work, or as anything of that sort.

Again, in the more complex form of volitional energy, Ostwald finds a further intimation of the transformation of physical into psychical phenomena, for he insists that psychical energy in the form of volition producing physical effects in the bodily organism and through the movements of the body upon the external world is more nearly akin to the concept of work or to that of the capacity for work. In support of this position, Ostwald treats at length of the sympathetic exhaustion induced throughout the entire nervous system whenever an excessive strain is put upon the will, and how the effort of the will in turn becomes sensitive to all excessive bodily fatigue.¹ However, while it is true that volitional phenomena and bodily phenomena are most intimately connected, this by no means proves that the essential nature of the one in any way expresses the essential nature of the other. The difficulty here is no other than that which confronts us in the transition from the nervous energy of the sense-organs to the accompanying consciousness, though it be of the most elementary kind. It presents only a more highly developed form of the relation which obtains between the physical and the psychical.

Moreover, if we compare the physical world as a whole, with the world of thought as a whole, we will find that the course of

¹ P. 247 f.

evolution is not the same in each. The development of the physical world is attended with a decrease of available energy, or as it is also expressed, by an increase of the so-called entropy. Whereas the world of thought on the other hand is constantly accumulating its store of available energy with each succeeding generation. Thought energy must therefore partake of an entirely different kind of being than that of physical energy. The stored thought of mankind conserved, for instance, in the great libraries of the world is evidently in a form far removed from anything which the concept of energy even in its potential state can possibly represent. Nor do we find it conserved in any conceivable form of energy amidst the traditions and institutions of a people.

Ostwald appears, moreover, in Kantian disguise when he insists that, at the last analysis, knowledge must be regarded as purely subjective, and that the phenomena of the external world become intelligible only through the fundamental forms which thought imposes upon them; and, therefore, inasmuch as the total content of knowledge may be conceived merely as varied manifestations of one and the same form of energy, it must follow that the essential nature of the thought which comprehends it is of the same energetic essence. Thus thought and the content of thought are identical.¹ It would seem that Ostwald has here wandered far afield from the primary ideal of a philosophy without hypothesis, which should be composed wholly of facts, swinging clear of all speculative obscuration and dogmatic construction. This is only another phase of that transition from the physical to the psychical which appears to be as easily effected by Ostwald the metaphysician as by Ostwald the physicist.

In this connection, also, Ostwald explains the consciousness of the personal identity of the subject or the ego as due to "the continuity of experiences in one brain, or in one mind."² If this continuity of experience is to be accounted for by one brain, that is, by the central nervous activity connecting and correlating the totality of manifold experiences into a systematic whole which is

¹ P. 394.² P. 411.

characterised by the self-consciousness of a personality looking before and after, then an absolutely extraordinary and impossible demand is made upon the brain, regarded solely as a physical organism.

If, on the other hand, this continuity of experience is provided for by the mind, that is by the subjective thought-centre, or ego, or psychical energy, or what you will, then its peculiar functions, both the elemental and the more highly developed, alike transcend any possible representation whatsoever by those fundamental properties of the concept of energy which forms the basis of Ostwald's system, and which is expressible in terms of mass and velocity, or in terms of work or capacity for work.

It is obvious therefore that if the primary concept of energy is so defined as to embrace psychical phenomena, we have no longer the simple concept of energy as understood and recognised in scientific circles or even among the *Energetiker* themselves; but if the psychical element does not occur in the original concept of energy, it can never be reached by any series of subsequent transitions or transformations, however many and complex they may be.

JOHN GRIER HIBBEN.

PRINCETON UNIVERSITY.